GENNUM CORPORATION

GT4124 Video Multiplier with Strobed DC Restore

DATA SHEET

FEATURES

- broadcast quality video multiplier with a very accurate back porch clamp, (less than 2mV DC offset)
- 30 MHz at -1.0dB video and control channel bandwidth
- one external frequency compensation adjustment
- ultra low differential gain and differential phase, (typically 0.01% and 0.01 deg.)
- adjustable DC offset and span on the control input
- adjustable clamp reference level
- active low STROBE input
- 20 pin PDIP and SOIC packaging.

APPLICATIONS

- Production switcher video mixers
- Linear Keyers

ORDERING INFORMATION

Part Number	Package Type	Temperature Range
GT4124-CDF	20 pin PDIP	0 to 70˚
GT4124-CKF	20 pin SOIC	0 to 70˚

DESCRIPTION

The GT4124 multiplier is a monolithic dual-channel video multiplier for use in the professional broadcast field. It incorporates a very fast and accurate strobed clamp to insure black level accuracy.

Featuring two wideband video inputs and a single control input, the GT4124 achieves high quality video mixing of the two synchronized video input signals to a single output by implementing the transfer function:

$$V_{OUT} = V_{IN_A} \bullet V_C + V_{IN_B}(1 - V_C)$$

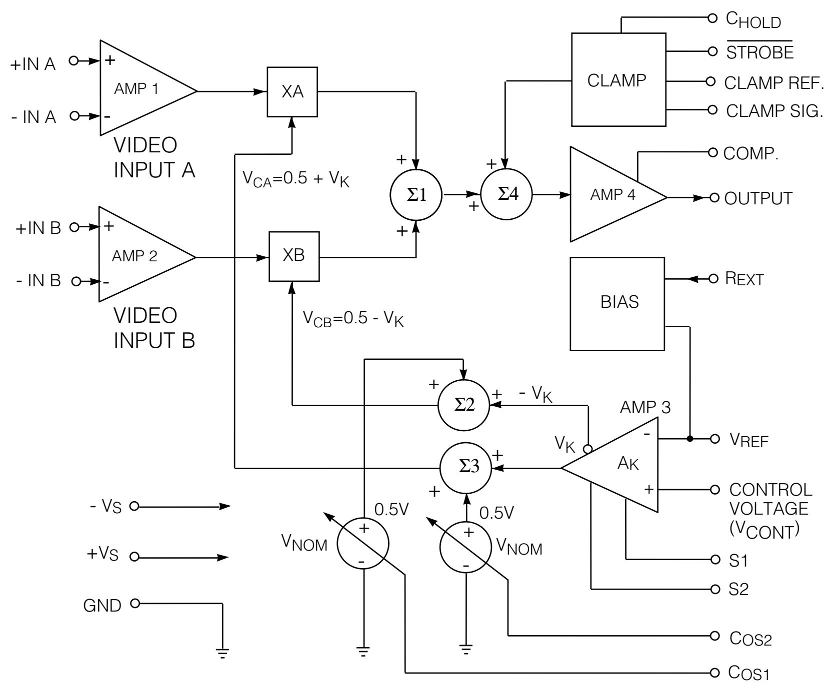
where V_C is the control input voltage, which may be varied over the control range, and VIN_A and VIN_B are the video input signals.

The GT4124 operates with power supply voltages of ±9 to ±12 volts. At a nominal supply of ±10 volts, it draws an average of 20 mA of current. The GT4124 is available in 20 pin PDIP and 20 pin SOIC packages.

An application note entitled "Using the GT4122 and GT4124 Video Mixer ICs" (Document 520-44) is available from Gennum Corporation.

PIN DESIGNATION

1	$+V_S$	positvive supply voltage
2	C_{HOLD}	clamp holding capacitor
3	COMP	output freq'y comp'n R-C
4	C_{OS1}	control input offset adjust
5	C_{OS2}	control input offset adjust
6	S1	span adjust
7	V_{REF}	0.5 volt reference input
8	S2	span adjust
9	V_{CONT}	control signal input
10	GND	ground
11	STROBE	strobe input
12	R_{EXT}	current setting resistor
13	+IN A	A video + signal input
14	-IN A	A video - signal input
15	CLAMP SIG	clamp signal
16	CLAMP REF	clamp reference
17	+IN B	B video + signal input
18	-IN B	B video - signal input
19	OUTPUT	video output
20	$-V_S$	negative supply voltage



Device Function: $V_{OUT} = A_{OL}\,[V_A\,(0.5+V_K) + V_B(0.5 - V_K)]$ where $A_{OL} \sim 2000$, $V_K=V_{CONT} - V_{REF}$, $AK \approx \frac{0.85\,R_{EXT}}{R_{SPAN}}$

FUNCTIONAL BLOCK DIAGRAM

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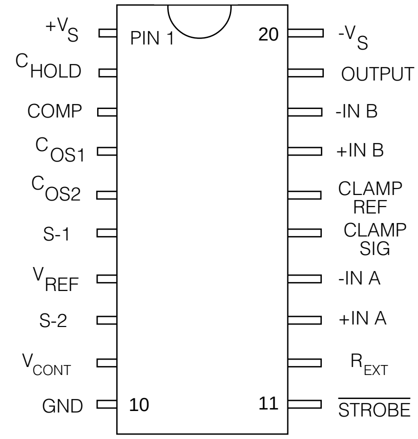
ABSOLUTE MAXIMUM RATINGS

PARAMETER	VALUE/UNITS
Supply Voltage (V_S)	±13.5 V
Operating Temperature Range	0° C ≤ T_A ≤ 70° C
Storage Temperature Range	-65° C ≤ T_S ≤ 150° C
Lead Temperature (Soldering, 10 Sec)	260° C
Differential Video Input Voltage	±5 V
Strobe Input Voltage	$V_{EE} \le V_{CLAMP} \le V_{CC}$

PIN CONNECTIONS

TOP VIEW



20 PIN DIP / SOIC

ELECTRICAL CHARACTERISTICS $+V_S = -V_S = 10V$, 0°C ≤ T_A ≤ 70°C unless otherwise shown

	PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
	Supply Voltage	$\pm V_S$	Operating Range	±9	±10	±12	volts
POWER	Supply Current (pos)	I^+	R_{EXT} = 1 kΩ	-	24	28	mA
SUPPLIES	Supply Current (neg)	I^-	R_{EXT} = 1 kΩ	-	18	20	mA
	Small Signal Bandwidth	BW	at ±0.1 dB V_{SIG} = 150 mVp-p	25	30	-	MHz
	Full Power Bandwidth	BW	at -3.0 dB V_{SIG} = 1 V p-p	20	25	-	MHz
	Frequency Response		DC - 10 MHz	-	±0.05	-	dB
	Differential Gain	∂g	V_{IN} = 40 IRE at 3.58 MHz	-	0.01	0.03	%
	Differential Phase	∂p	V_{IN} = 40 IRE at 3.58 MHz	-	0.01	0.03	degrees
SIGNAL	Signal to Noise	S/N	V_{SIG} = 1 volt, BW = 5 MHz	64	70	-	dB
CHANNEL	Gain - open loop	A_{OL}	100 kHz (ß = 0%)	54	60	66	dB
	Gain - closed loop	A_{CL}	100 kHz (ß = 100%)	-0.01	-0.005	-	dB
	Phase Delay	td_{SIG}		-	-	10	ns
	Off Isolation & Crosstalk	$V_{A\text{ or }B}/V_O$	f_{SIG} = 5 MHz (see note 1)	80	85	-	dB
		$V_C/V_{A\text{ or }B}$	f_{SIG} = 5 MHz (see note 2)	90	95	-	dB
	Bandwidth	BW	at ±0.1 dB V_{SIG} = 150 mVp-p	25	30	-	MHz
CONTROL	Phase Delay	$t_{d\,CONT}$		-	-	10	ns
CHANNEL	Linearity			-	1	-	%
	Control Breakthrough		V_{CONT} = 0-1 V f = 1-10 MHz	-	-55	-50	dB
	Crossfade Balance		V_{CONT} = 0-1 V f = 3.58 MHz	-	3	5	mVpp
	Control Range	V_{CONT}		-5	-	+5	V
	$\overline{\text{Strobe}}$ Pulse Width			500	1000	-	ns
	$\overline{\text{Strobe}}$ Level	V_{INHI}		2.0	-	-	V
		V_{INLO}		-	-	0.8	V
	Clamp Accuracy			-	±1	±2	mV

Notes:
1. $V_{A\text{ or }B}$ = 1 Vp-p output taken from OUTPUT
2. V_{CONT} = 1 Vp-p output taken from V_A or V_B

DETAILED DESCRIPTION

The GT4124 is a broadcast quality monolithic integrated circuit specifically designed to linearly mix two video signals under the control of a third channel.

Referring to the Functional Block Diagram, the input signals are applied to conventional differential amplifiers (AMP1 and AMP2) whose offsets are trimmed by on-chip resistors.

Following each input amplifier, the signals are applied to linear multiplier circuits (XA and XB) whose outputs are the product of the incoming signals and controlling voltages (V_{CA}) or (V_{CB}). The controlling voltage V_{CA} is the sum of a nominal 0.5V source (V_{NOM}) and a variable source V_K while V_{CB} is made up of the sum of the nominal voltage V_{NOM} and $-V_K$.

V_K and $-V_K$ are themselves proportional to the difference between an externally applied reference voltage (V_{REF}) and an externally applied CONTROL voltage (V_C). The voltages V_K and $-V_K$ are produced by a differential amplifier (AMP3) whose gain is A_K. This gain can be altered by two external resistors, R_{EXT} and R_{SPAN} according to the following formula:

$$A_K \approx \frac{0.85 \bullet R_{EXT}}{R_{SPAN}} \qquad [1k\Omega < R_{EXT} < 3k\Omega]$$

Note that R_{EXT} is connected between the R_{EXT} pin and ground and R_{SPAN} is connected between the pins S1 and S2.

Each of the voltages ($+V_K$ and $-V_K$) is applied to summing circuits (Σ2 and Σ3) whose second inputs are DC voltage sources that can also be slightly varied. The nominal value of these voltage sources is 0.5 volts. When they are exactly 0.5V and when $V_C = V_{REF}$ then the gain of each signal channel of the mixer is 0.5 (50%).

By connecting the ends of an external potentiometer (CONTROL OFFSET) between the offset pins COS1 and COS2, the voltage sources can be altered differentially. If a second potentiometer (50% GAIN) is connected between the wiper of the CONTROL OFFSET potentiometer and the supply voltage, the voltage sources can be varied in a common mode fashion.

In this way not only can the control range of the mixer be varied but also the point at which 50% of each input signal appears at the output.

The outputs from the multiplier circuits (XA and XB) are then applied to a summing circuit (Σ1) whose output feeds a wideband amplifier (AMP4) via a second summing circuit (Σ4) and presents the mixed signals to the outside world.

The GT4124 includes the strobed clamp block. This circuit samples the output signal when CLAMP SIG. is connected to the OUTPUT, and compares it to a CLAMP REFERENCE voltage which normally is set to 0V.

During the strobe period, which is usually the back porch period of the video signal, DC feedback is applied to the summing circuit Σ4 such that the DC offset is held to within one or two millivolts of the clamp REFERENCE.

A holding capacitor C_{HOLD} is used to assure effective clamp operation and filter residual noise.

Although there are two separate differential inputs, the usual operational amplifier gain-setting methods can be applied to determine the closed loop gain of the mixer. Usually the mixer will be configured for unity gain by connecting both inverting inputs (-IN A , -IN B) to the common output (OUT). In this case, the general transfer function is:

$$V_O = V_A \bullet [V_{NOM} + A_K \bullet (V_C - V_{REF})] + V_B \bullet [V_{NOM} - A_K \bullet (V_C - V_{REF})]$$

(Unity gain configuration)

Where V_A and V_B are the input analog signals applied to +IN A and +IN B respectively, and V_C is the CONTROL voltage.

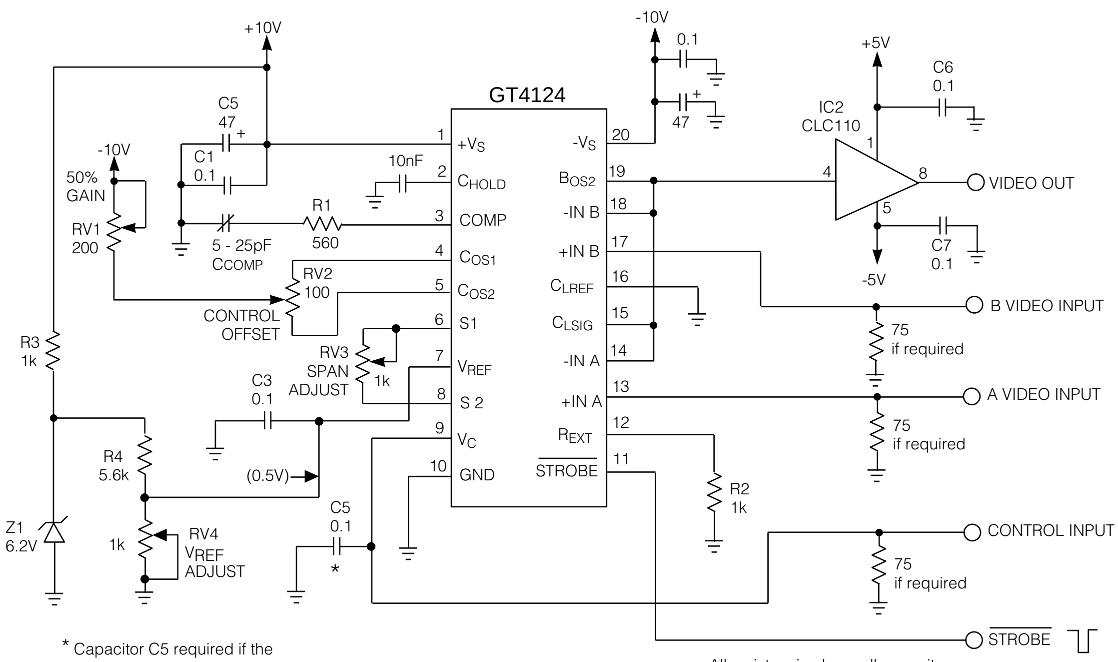
Note that V_{NOM} ranges between $0.45V < V_{NOM} < 0.55$.

For normal video mixer operation, the control range (SPAN) is usually 0 to 1V and will occur when A_K=1, V_{REF}= 0.5V and V_{NOM}=0.5 volts. A change in V_C from 0 to 1V will then produce an effect such that the output signal contains 100% of Channel B when V_C is 0V and 100% of Channel A when V_C is 1 volt. For the above conditions, the general unity gain transfer function reduces to:

$$V_O = V_A \bullet V_C + V_B \bullet (1 - V_C)$$

Since the operation of the mixer is limited to two quadrants, no signal inversions occur if the control voltage exceeds the range zero to one volt in either direction.

The topology is designed so that once the control voltage reaches either end of its range, the channel which is ON remains fully ON and the OFF channel remains fully OFF.



* Capacitor C5 required if the control voltage is from a power supply.

All resistors in ohms, all capacitors in F unless otherwise stated.

Fig. 1   Test Circuit

TYPICAL PERFORMANCE CURVES

(unless otherwise shown $V_S = \pm 10V$)

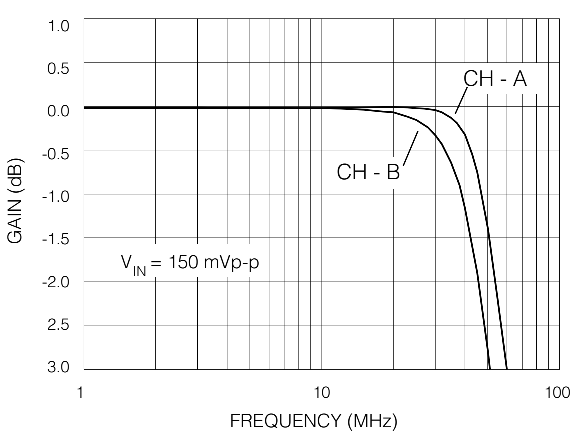


Fig. 2   Gain vs Frequency

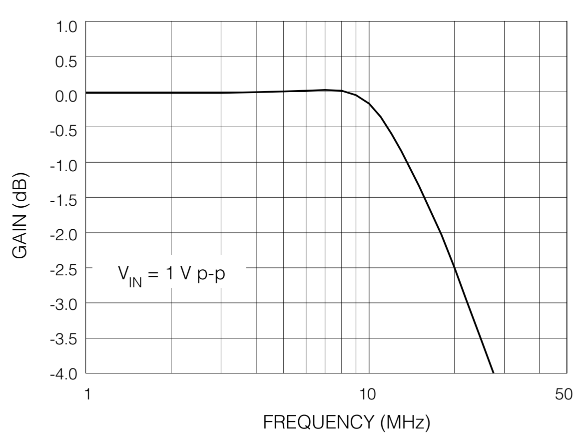


Fig. 3   Full Power Bandwidth

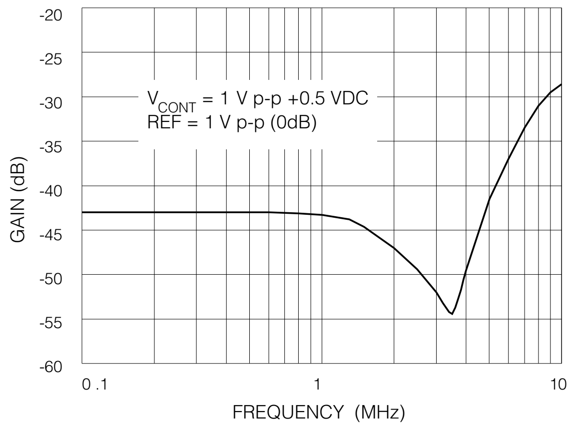


Fig. 4 Crossfade Balance vs Frequency

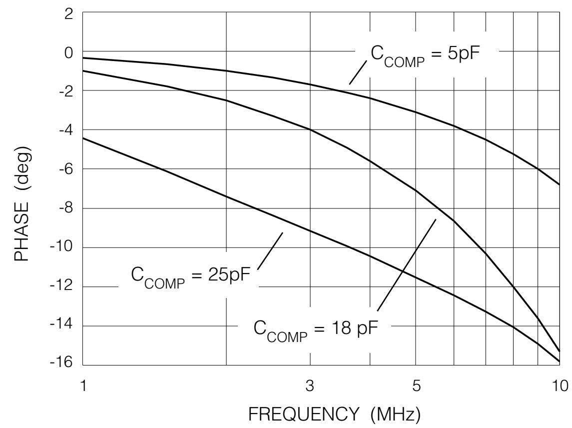


Fig. 5 Phase Delay vs Frequency

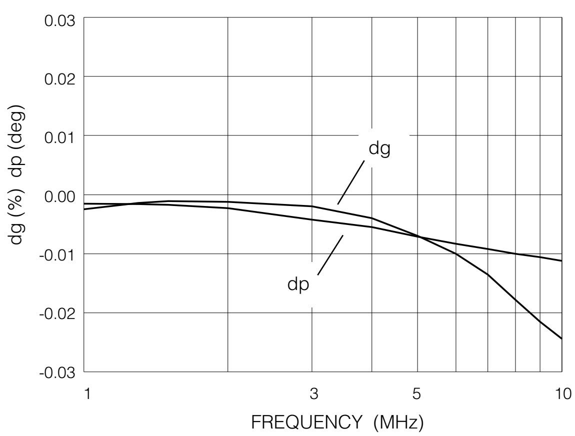


Fig. 6 Differential Gain and Phase vs Frequency

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ELECTROSTATIC
SENSITIVE DEVICES
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EXCEPT AT A STATIC-FREE WORKSTATION

DOCUMENT
IDENTIFICATION

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